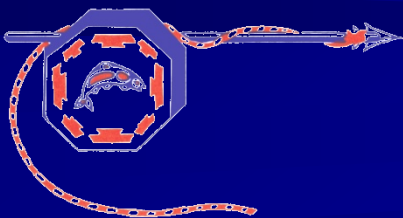


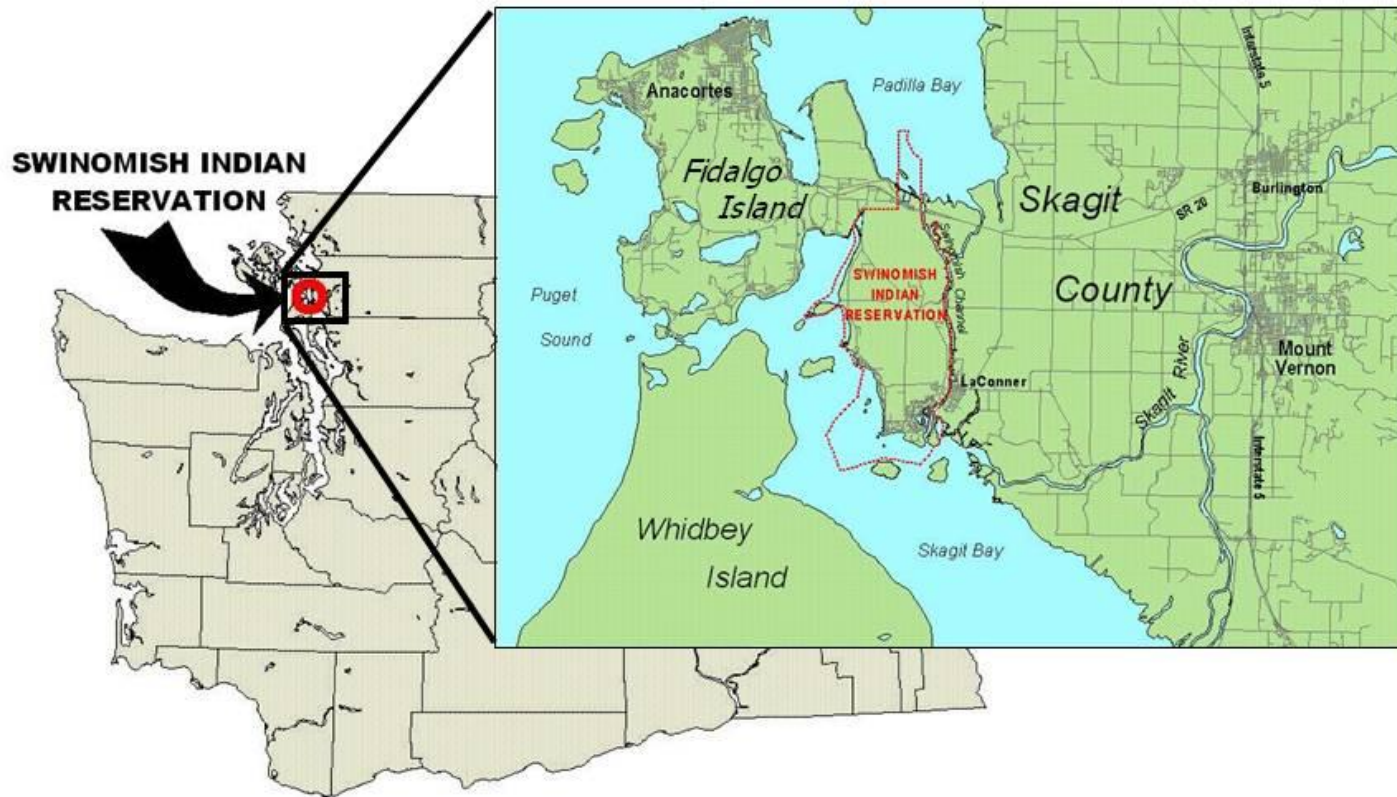


# **Local Response to Climate Change: Swinomish Case Study**



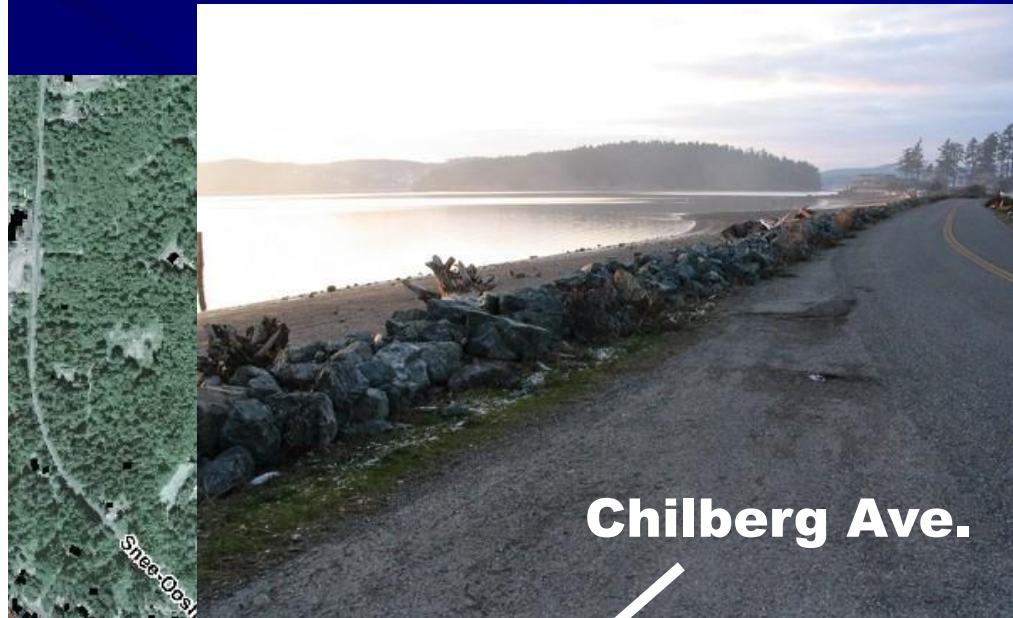
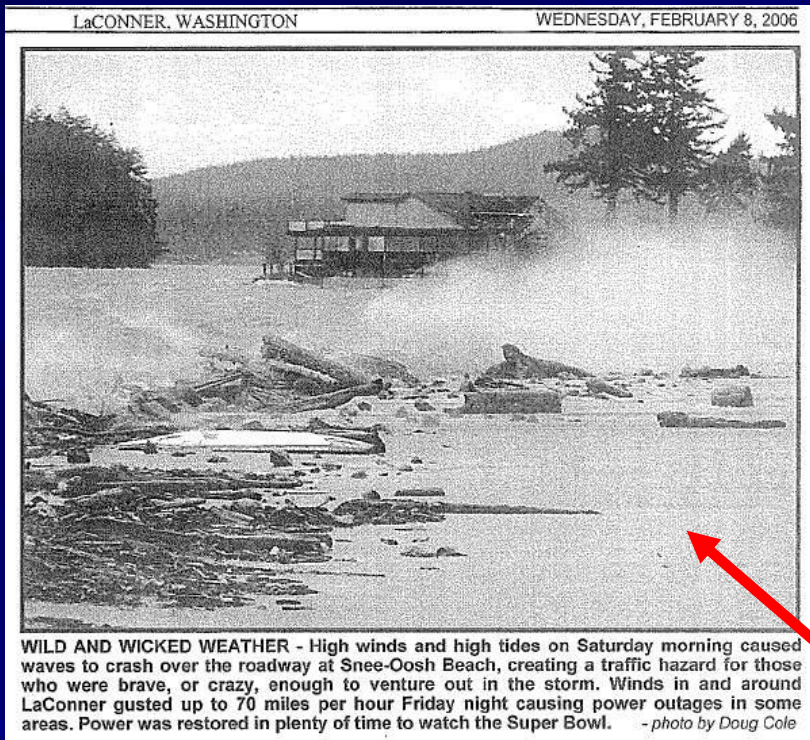
**Swinomish Indian Tribal  
Community**

# Location of Swinomish Indian Reservation





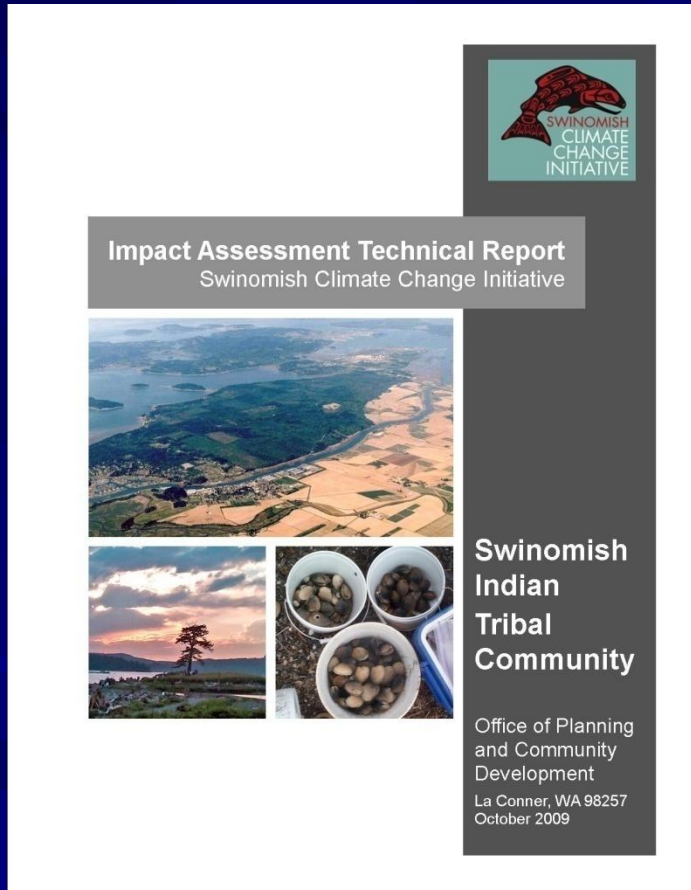
# Storm surge, February 2006



# **Swinomish Climate Change Initiative**

- **Focus is local impacts, adaptation**
- **Two-year, \$400,000 project**
- **80% federal funding, 20% Tribal**
- **First year: Impact assessment, publish technical report (Oct. 2009)**
- **Second year: Develop strategy options, publish Action Plan (Sept. 2010)**

# Impact Assessment Technical Report

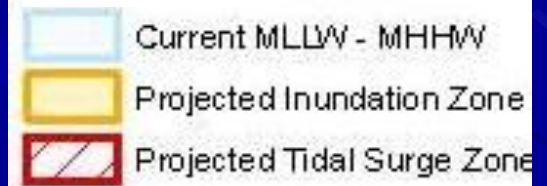
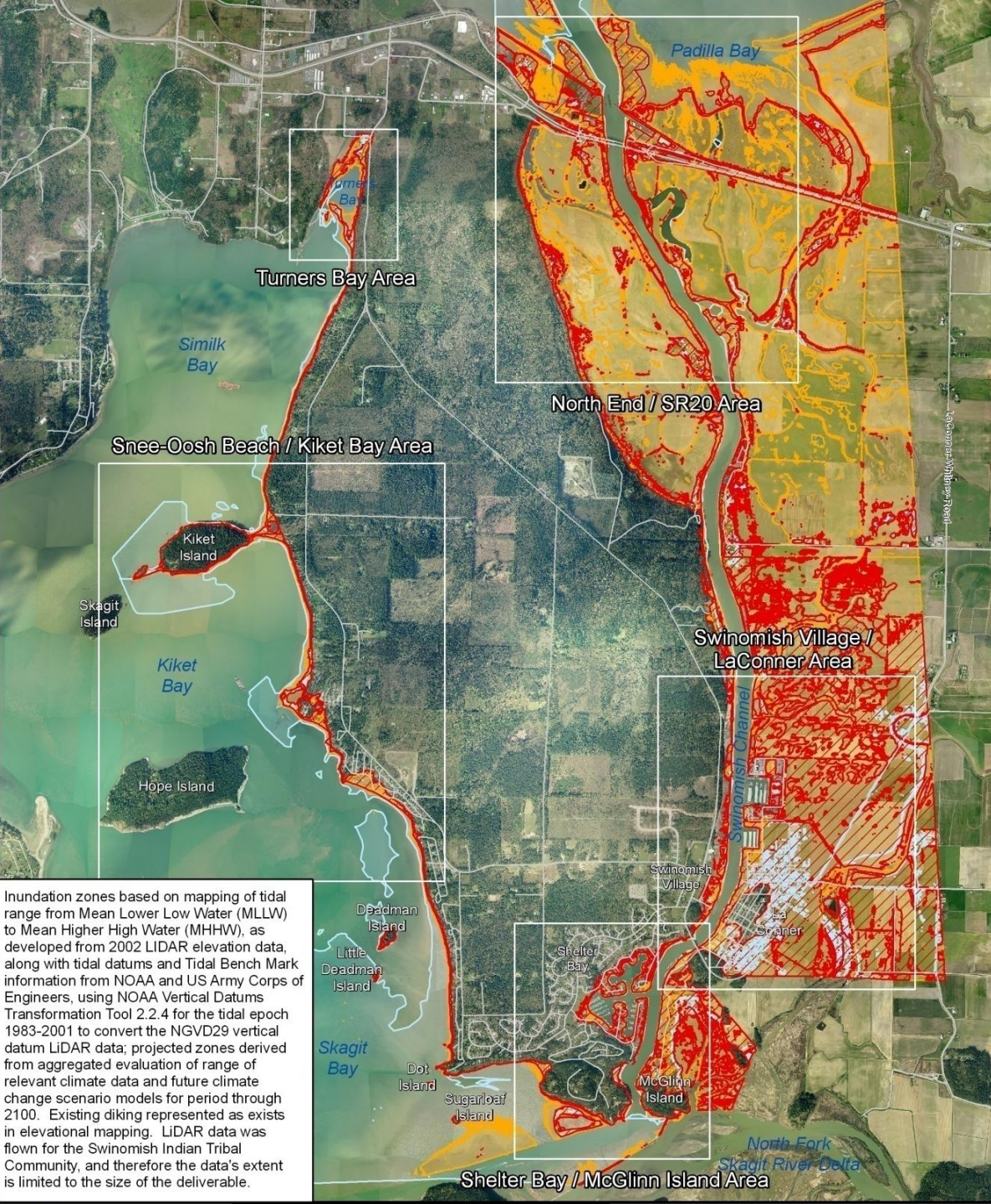


- Review of climate data
- Broad impact analysis
- Many disciplines/sectors
- Risk zone mapping
- Inventory of at-risk assets
- Vulnerability assessment
- Risk analysis
- Basis for Action Plan

# Climate Change Impacts

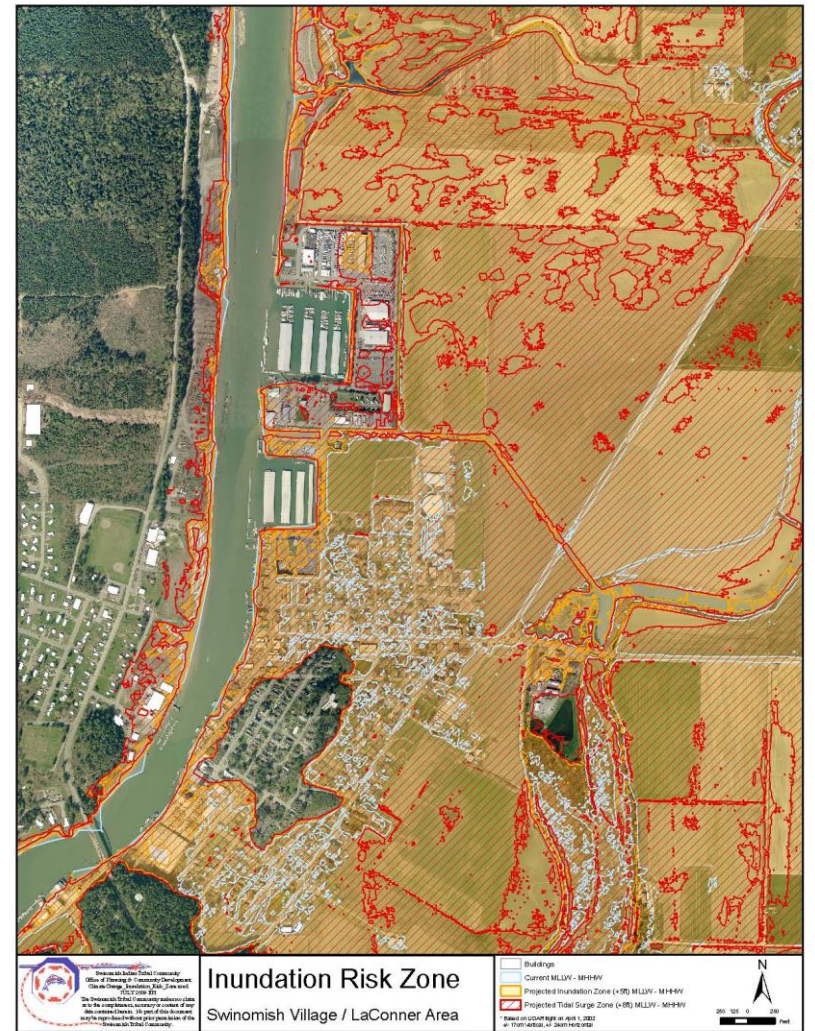
- Sea Level Rise risk of inundation and storm surge homes, infrastructure and shoreline resources.
- Wildfire Risk to homes especially in forest urban fringe.
- Health risks from heat events and increases in respiratory ailments.
- Risks to water supplies and waste water Treatment facilities.

# Inundation Risk Zones – Sea Level Rise & Tidal Surge

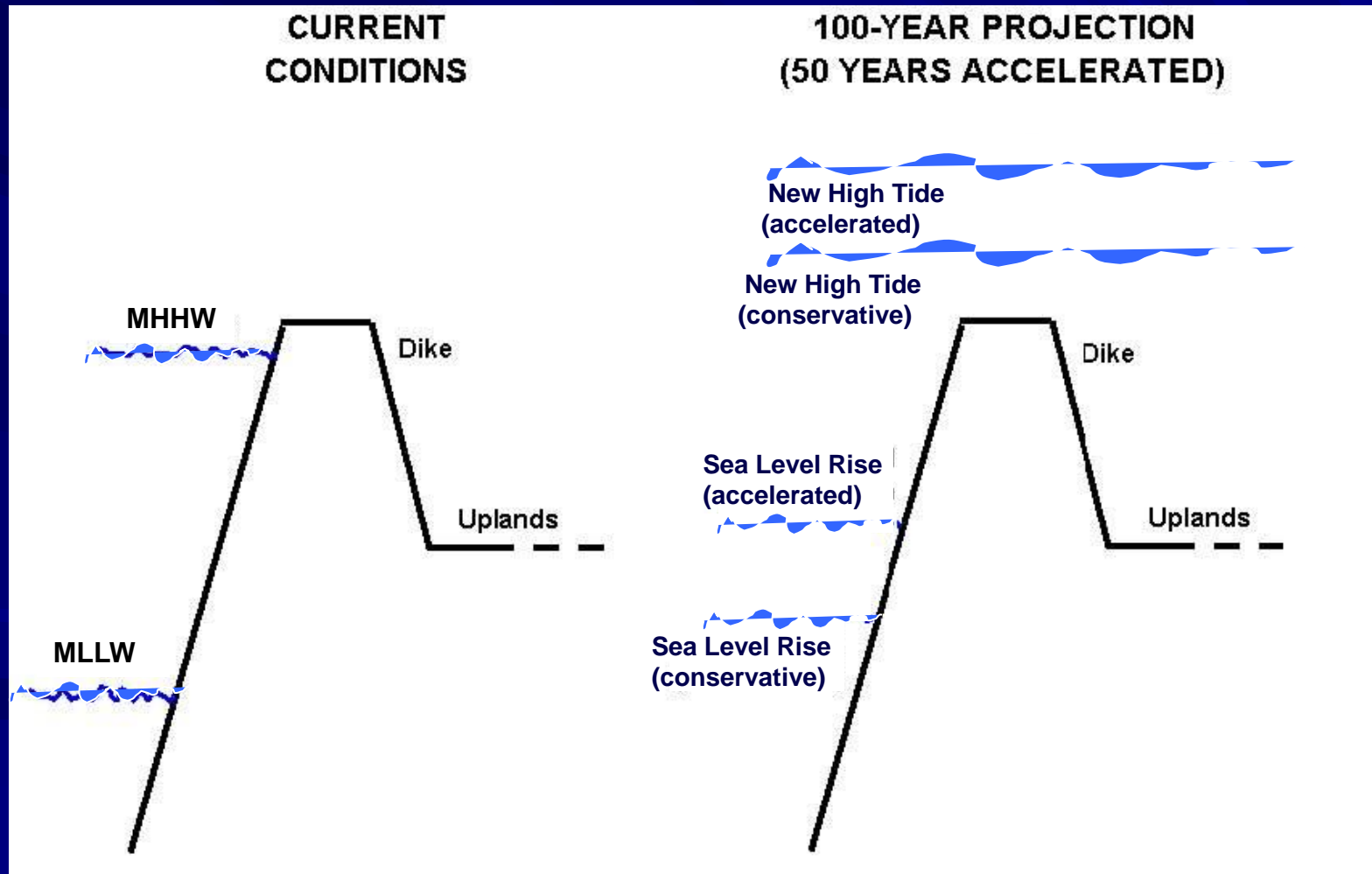


\* Based on LIDAR flight on April 1, 2002  
 +/- 17cm Vertical, +/- 24cm Horizontal

# Inundation Risk Zones – detail



# Sea level rise scenarios, low-lying areas



# Potential sea level rise impacts – built environment

- ~1,100 low-lying acres at risk
- 180 structures, over \$100 million value
- Access/transportation links at risk
- Economic development land at risk
- Impaired marine/port facilities
- Erosion, flood damage from storm surges

# Threats to Shoreline and Near Shore Habitat

- **Loss of shoreline/shellfish habitat**
- **Stressed fish / shellfish populations**
- **Permanent species relocation/migration**
- **Threats from invasive species**
- **Loss of forage fish spawning beaches**
- **Loss of eel grass beds**
- **Hardened shorelines with resulting impacts.**

# Counter-Productive Response

- To protect at risk homes, roads and pipelines – first response may be to build bulkheads to hold back the sea.
- This will block any upward migration of shoreline habitats.
- Eventually squeezing out shorelines/beaches as permanent inundation meets vertical walls.



Bulkhead

# Evolution of a Marsh as Sea Level Rises

5,000 Years Ago



Today



Future

Substantial Wetland Loss Where House is Moved or Upland is Vacant



Complete Wetland Loss Where House is Protected with Bulkhead in Response to Rise in Sea Level



## LEGEND



Sedimentation and Peat Formation



Marsh

Coastal marshes have kept pace with the slow rate of sea level rise that has characterized the last several thousand years. Thus, the area of marsh has expanded over time as new lands have been inundated. If in the future, sea level rises faster than the ability of the marsh to keep pace, the marsh area will contract. Construction of bulkheads to protect economic development may prevent new marsh from forming and result in a total loss of marsh in some areas.

Source: Titus, J.G. 1991. Greenhouse Effect and Coastal Wetland Policy, *Environmental Management* 15(1):39-58.

# Allow for Habitat Migration

- To retain tideland and shoreline habitats relocate homes and infrastructure away from shoreline and not harden banks.
- Id critical areas to retreat and allow / encourage shoreline habitat migration and adaptation.
- Determine where and when dike setback or removal should be done.
- Plan long-term in actions taken now.

# Current Project: Tribal Code Amendments to Address SLR

- Review Tribal codes for amendments to improve adaptation response.
- Shorelines and Sensitive Areas
- Building and Zoning Codes
- Key issues:
  - Reduce future building in SLR Risk Zones
  - Provide for Shoreline Migration in key areas
  - Prevent hardening of shorelines
  - Address shifts in shorelines and ownership

# Future Swinomish Projects on SLR

- Determine Where to Retreat
  - Relocate infrastructure
  - Acquire private lands and homes
  - Remove shoreline protection structures.
  
- Study of Dikes and Ag Lands to determine
  - Where to raise lands for economic development
  - To remove or setback dikes
  - How long will agriculture be feasible and when to convert to estuarine wetlands or other uses.

# Sources

- **Swinomish Climate Change Initiative: Impact Assessment Technical Report.** October 2009. Swinomish Indian Tribal Community.
- **Swinomish Climate Change Initiative: Adaptation Plan.** September 2010. Swinomish Indian Tribal Community.
- **Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use.** October 2011. Georgetown Climate Center.
- **Rolling Easements: Options for Ensuring that Wetlands and Beaches Have Room to Migrate Inland as Sea Level Rises. [Draft 2012].** James Titus, US EPA.